

**We claim:**

1. A chemical compound of the general formula

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wherein

$X_1$  is a leaving group,

$R_2$  is a cycloalkyl having from 3 to 16 carbon atoms, an aryl having from 5 to 18 carbon atoms or a polycyclic alkyl group having from 7 to 16 carbon atoms,  
10 and

$R_1$  is a substituent of  $R_2$  selected from alkyl groups having from 1 to 4 carbon atoms, alkenyl groups having from 2 to 5 carbon atoms, alkynyl groups having from 2 to 5 carbon atoms, and aromatic groups having 5 or 6 carbon  
15 atoms, each of said groups being optionally substituted, and Cl and F.

2. The chemical compound of claim 1, wherein

$X_1$  is a leaving group selected from halogen, acyloxy, alkoxy and OH groups,

$R_2$  is an aromatic group having 5 or 6 carbon atoms or a non-aromatic ring structure having  
20 from 5 to 7 carbons, and

$R_1$  is a substituent at position 4 of  $R_2$  selected from alkyl groups having from 1 to 4 carbon atoms, alkenyl groups having from 2 to 5 carbon atoms, alkynyl groups having from 2 to 5 carbon atoms, and aromatic groups having 5 or 6 carbon atoms, each of said groups being optionally substituted, and Cl and F.  
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3. The compound of claim 1 or 2, wherein  $R_1$  is a linear or branched carbon chain having from 1 to 4 carbons, which is optionally fluorinated or perfluorinated.

4. The compound of any of claims 1 to 3, wherein

30  $R_1$  is selected from the group consisting of  $-CF_3$ ,  $-CF_2CF_3$ ,  $-CF_2CF_2CF_3$ ,  $-CF_2OH$ ,  $-CF_2CF_2OH$ ,  $-CF_2(CF_2)_2OH$ ,  $-CF_2(CF_2)_2CF_3$ ,  $-CF_2(CF_2)_3OH$ , a carbon chain having a carbon-carbon double bond and from 2 to 5 carbons, a vinyl group, an acrylic group, an alkenyl group having from 1 to 4 carbons, and  $-Si-(X_2)_3$ , where  $X_2$  is a halogen.

5. The compound of any of claims 1 to 4, wherein X<sub>1</sub> is chlorine or ethoxy,
  6. The compound according to claim 4 or 5, wherein X<sub>2</sub> is chlorine.
- 5 7. The compound of any of claims 1 to 6, wherein R<sub>2</sub> is an aromatic group selected from the group of aromatic groups having 5 or 6 carbon atoms and further being substituted at positions 3 and 5.
8. The compound of claim 7, wherein R<sub>2</sub> is substituted at positions 3 and 5 with a group
- 10 -CF<sub>3</sub>.
9. The compound of claim 1 or 2, wherein R<sub>1</sub> is -CH<sub>3</sub>, -CH<sub>2</sub>CH<sub>3</sub>, -CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>, -(CH<sub>2</sub>)CF<sub>3</sub>, -CH<sub>2</sub>CH<sub>2</sub>OH or -CH<sub>2</sub>CF<sub>2</sub>OH.
- 15 10. A poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain cross-linking groups and -R<sub>1</sub>-R<sub>2</sub> bound to from 5 % to 50 % of the silicon atoms in the Si-O backbone, wherein R<sub>2</sub> is an aromatic group having 6 carbon atoms and R<sub>1</sub> is a substituent at position 4 of R<sub>2</sub>.
- 20 11. The compound of claim 10, wherein  
X<sub>1</sub> is a halogen, acyloxy, alkoxy or OH group,  
R<sub>2</sub> is an aromatic group having 5 or 6 carbon atoms or a non-aromatic ring structure having from 5 to 7 carbons, and  
R<sub>1</sub> is a substituent at position 4 of R<sub>2</sub> selected from alkyl groups having from 1 to 4 carbon atoms, alkenyl groups having from 2 to 5 carbon atoms, alkynyl groups having from 2 to 5 carbon atoms, and aromatic groups having 5 or 6 carbon atoms, each of said groups being optionally substituted, and Cl and F.
- 25 12. The compound of claim 10 or 11, wherein R<sub>1</sub> is a linear or branched carbon chain having from 1 to 4 carbons, which is optionally fluorinated or perfluorinated.
- 30 13. The compound of any of claims 10 to 12, wherein R<sub>1</sub> is selected from the group consisting of -CF<sub>3</sub>, -CF<sub>2</sub>CF<sub>3</sub>, -CF<sub>2</sub>CF<sub>2</sub>CF<sub>3</sub>, -CF<sub>2</sub>OH, -CF<sub>2</sub>CF<sub>2</sub>OH, -CF<sub>2</sub>(CF<sub>2</sub>)<sub>2</sub>OH, -CF<sub>2</sub>(CF<sub>2</sub>)<sub>2</sub>CF<sub>3</sub>,

$-\text{CF}_2(\text{CF}_2)_3\text{OH}$ , a carbon chain having a carbon-carbon double bond and from 2 to 5 carbons, a vinyl group, an acrylic group, an alkenyl group having from 1 to 4 carbons, and  $-\text{Si}-(\text{X}_2)_3$ , where  $\text{X}_2$  is a halogen.

- 5    14. The compound of any of claims 10 to 13, wherein  $\text{X}_1$  is chlorine or ethoxy,
15. The compound according to claims 13 or 14, wherein  $\text{X}_2$  is chlorine.
- 10    16. The compound of any of claims 10 to 15, wherein  $\text{R}_2$  is an aromatic group selected from the group of aromatic groups having 5 or 6 carbon atoms and further being substituted at positions 3 and 5.
17. The compound of claim 16, wherein  $\text{R}_2$  is substituted at positions 3 and 5 with a group  $-\text{CF}_3$ .
- 15    18. The compound of claim 10, wherein  $\text{R}_1$  is  $-\text{CH}_3$ ,  $-\text{CH}_2\text{CH}_3$ ,  $-\text{CH}_2\text{CH}_2\text{CH}_3$ ,  $-\text{(CH}_2)\text{CF}_3$ ,  $-\text{CH}_2\text{CH}_2\text{OH}$  or  $-\text{CH}_2\text{CF}_2\text{OH}$ . wherein  $\text{R}_1$  is a carbon chain of from 1 to 4 carbons.
- 20    19. The compound of claim 10, wherein  $\text{R}_1$  is a carbon chain having a carbon-carbon double bond and from 2 to 5 carbons.
20. The compound of claim 19, wherein  $\text{R}_1$  is a vinyl group.
- 25    21. The compound of claim 19, wherein  $\text{R}_1$  is an acrylic group.
22. The compound of claim 10, wherein  $\text{R}_2$  is a non-aromatic ring structure having from 5 to 7 carbons.
- 30    23. The compound of claim 10, wherein the Si-O backbone further comprises  $\text{R}_3$  groups bound to from 5% to 25% of the silicon atoms in the Si-O backbone, wherein  $\text{R}_3$  is an alkyl chain having from 1 to 4 carbon atoms, an alkenyl chain or aryl group

24. The compound of claim 23, wherein R<sub>3</sub> is a non-fluorinated or partially fluorinated or perfluorinated hydrocarbon chain.

25. The compound of claim 24, wherein R<sub>3</sub> is CF<sub>3</sub>, CH<sub>3</sub>, CH<sub>2</sub>CH<sub>3</sub>, or CF<sub>2</sub>CF<sub>3</sub>.

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26. The compound of claim 23, wherein R<sub>3</sub> is a carbon chain having from 1 to 4 carbon atoms and an -OH group.

27. The compound of claim 26, wherein R<sub>3</sub> is CF<sub>2</sub>OH or CF<sub>2</sub>CF<sub>2</sub>OH.

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28. The compound of claim 26, having a dielectric constant of 2.7 or less, preferably 2.5 or less, in particular 2.3 or less.

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29. A poly(organo siloxane) compound comprising a repeating Si-O backbone, -R<sub>1</sub>-R<sub>2</sub> bound to from 25% to 50% of the silicon atoms in the Si-O backbone, wherein R<sub>2</sub> is an aromatic group having 6 carbon atoms and R<sub>1</sub> is a substituent at position 4 of R<sub>2</sub> (again this could be drawn out for clarity), and R<sub>3</sub> bound to from 5% to 50% of the silicon atoms, wherein R<sub>3</sub> is an alkenyl group having from 2 to 5 carbon atoms, acrylic group or epoxy group.

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30. The compound of claim 29, wherein R<sub>1</sub> is a linear or branched carbon chain having from 1 to 4 carbons, which is optionally fluorinated or perfluorinated.

31. The compound of claim 29 or 30, wherein

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R<sub>1</sub> is selected from the group consisting of -CF<sub>3</sub>, -CF<sub>2</sub>CF<sub>3</sub>, -CF<sub>2</sub>CF<sub>2</sub>CF<sub>3</sub>, -CF<sub>2</sub>OH, -CF<sub>2</sub>CF<sub>2</sub>OH, -CF<sub>2</sub>(CF<sub>2</sub>)<sub>2</sub>OH, -CF<sub>2</sub>(CF<sub>2</sub>)<sub>2</sub>CF<sub>3</sub>, -CF<sub>2</sub>(CF<sub>2</sub>)<sub>3</sub>OH, a carbon chain having a carbon-carbon double bond and from 2 to 5 carbons, a vinyl group, an acrylic group, an alkenyl group having from 1 to 4 carbons, and -Si-(X<sub>2</sub>)<sub>3</sub>, where X<sub>2</sub> is a halogen.

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32. The compound of any of claims 29 to 30, wherein X<sub>1</sub> is chlorine or ethoxy,

33. The compound according to claim 31 or 32, wherein X<sub>2</sub> is chlorine.

34. The compound of any of claims 29 to 33, wherein R<sub>2</sub> is an aromatic group selected from the group of aromatic groups having 5 or 6 carbon atoms, such as phenyl, and further being substituted at positions 3 and 5.

5 35. The compound of claim 34, wherein R<sub>2</sub> is substituted at positions 3 and 5 with a group -CF<sub>3</sub>.

36. The compound of claim 29, wherein R<sub>1</sub> is -CH<sub>3</sub>, -CH<sub>2</sub>CH<sub>3</sub>, -CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>, - (CH<sub>2</sub>)CF<sub>3</sub>, -CH<sub>2</sub>CH<sub>2</sub>OH or -CH<sub>2</sub>CF<sub>2</sub>OH.

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37. The compound of claim 29, wherein R<sub>3</sub> is an epoxy group, such as a glycidoxypipropyl group, an acrylic group, an acryl group, such as a methacrylic group, an alkenyl group having from 2 to 5 carbon atoms, a vinyl group.

15 38. The compound of any of claims 29 to 37, further comprising R4 groups bound to from 5 to 50% of the silicon atoms of the Si-O backbone, wherein R4 is an alkyl group having from 1 to 4 carbon atoms.

20 39. The compound of claim 38, wherein R4 is CH<sub>3</sub>, CH<sub>2</sub>CH<sub>3</sub>, (CH<sub>2</sub>)<sub>2</sub>CH<sub>3</sub>, CF<sub>3</sub>, CF<sub>2</sub>CF<sub>3</sub> or (CF<sub>2</sub>)<sub>2</sub>CF<sub>3</sub>.4

40. The compound of any of claims 29 to 39, having a dielectric constant of 2.7 or less, preferably 2.5 or less, in particular 2.5 or less.

25 41. An integrated circuit having a layer with areas of an electrically conductive first material and an electrically insulating second material, wherein the second material is a poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain crosslinking groups and -R1-R2 bound to from 5% to 50% of the silicon atoms in the Si-O backbone, wherein R<sub>2</sub> is an aromatic group having 6 carbon atoms and R<sub>1</sub> is a substituent 30 at position 4 of R<sub>2</sub>.

42. The circuit of claim 41, wherein R<sub>1</sub> is a linear or branched carbon chain having from 1 to 4 carbons, which is optionally fluorinated or perfluorinated.

43. The compound of claim 41 or 42, wherein

R<sub>1</sub> is selected from the group consisting of -CF<sub>3</sub>, -CF<sub>2</sub>CF<sub>3</sub>, -CF<sub>2</sub>CF<sub>2</sub>CF<sub>3</sub>, -CF<sub>2</sub>OH, -CF<sub>2</sub>CF<sub>2</sub>OH, -CF<sub>2</sub>(CF<sub>2</sub>)<sub>2</sub>OH, -CF<sub>2</sub>(CF<sub>2</sub>)<sub>2</sub>CF<sub>3</sub>, -CF<sub>2</sub>(CF<sub>2</sub>)<sub>3</sub>OH, a carbon chain having a carbon-carbon double bond and from 2 to 5 carbons, a vinyl group, an acrylic group, an

5 alkenyl group having from 1 to 4 carbons, and -Si-(X<sub>2</sub>)<sub>3</sub>, where X<sub>2</sub> is a halogen.

44. The compound of any of claims 41 to 43, wherein X<sub>1</sub> is chlorine or ethoxy,

45. The compound according to claim 43 or 44, wherein X<sub>2</sub> is chlorine.

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46. The compound of any of claims 42 to 45, wherein R<sub>2</sub> is an aromatic group selected from the group of aromatic groups having 5 or 6 carbon atoms, such as phenyl, and further being substituted at positions 3 and 5.

15 47. The compound of claim 46, wherein R<sub>2</sub> is substituted at positions 3 and 5 with a group -CF<sub>3</sub>.

48. The compound of claim 42, wherein R<sub>1</sub> is -CH<sub>3</sub>, -CH<sub>2</sub>CH<sub>3</sub>, -CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>, -(CH<sub>2</sub>)CF<sub>3</sub>, -CH<sub>2</sub>CH<sub>2</sub>OH or -CH<sub>2</sub>CF<sub>2</sub>OH.

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49. The compound of claim 42, wherein R<sub>2</sub> is a non-aromatic ring structure having from 5 to 7 carbons.

25 50. The compound of any of claims 42 to 49, wherein X<sub>1</sub> is an alkoxy group, ethoxy group, acyloxy group, an OH group.

51. The compound of any of claims 42 to 50, wherein R<sub>1</sub> is CH<sub>2</sub>, CH<sub>2</sub>CH<sub>3</sub>, (CH<sub>2</sub>)<sub>2</sub>CH<sub>3</sub>, (CH<sub>2</sub>)CF<sub>3</sub>, CH<sub>2</sub>CH<sub>2</sub>OH or CH<sub>2</sub>CF<sub>2</sub>OH.

30 52. A computer comprising an integrated circuit having a layer with areas of an electrically conductive first material and an electrically insulating second material, wherein the second material is a poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain crosslinking groups and -R<sub>1</sub>-R<sub>2</sub> bound to from 5% to 50% of the

silicon atoms in the Si-O backbone, wherein R<sub>2</sub> is an aromatic group having 6 carbon atoms and R<sub>1</sub> is a substituent at position 4 of R<sub>2</sub>).

53. A method for making an integrated circuit, comprising providing alternating areas of 5 electrically insulating and electrically conducting materials within a layer on a semiconductor substrate, wherein the electrically insulating material comprises a poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain crosslinking groups and -R<sub>1</sub>-R<sub>2</sub> bound to from 5% to 50% of the silicon atoms in the Si-O backbone, wherein R<sub>2</sub> is an aromatic group having 6 carbon atoms and R<sub>1</sub> is a substituent 10 at position 4 of R<sub>2</sub> selected from an alkyl chain having from 1 to 4 carbons, an alkenyl group having from 2 to 6 carbons or OH.

54. The method of claim 53, wherein the electrically insulating material is deposited, baked and patterned, with the electrically conductive material being deposited in removed 15 areas of the patterned dielectric.

55. The method of claim 54, wherein the electrically conductive material comprises copper.

20 56. The method of claim 55, which is a dual damascene process.

57. A method of making a chemical compound of the formula R<sub>1</sub>-R<sub>2</sub>-Si-(X<sub>2</sub>)<sub>3</sub>, wherein X<sub>2</sub> is a halogen, R<sub>2</sub> is an aromatic group having 5 to 18 carbon atoms, a cycloalkyl having from 3 to 16 carbon atoms, or a polycyclic alkyl group having from 7 to 16 carbon atoms, 25 and R<sub>1</sub> is a substituent, in particular at position 4 of R<sub>2</sub>, R<sub>1</sub> being selected from the group consisting of alkyl groups having from 1 to 4 carbon atoms, alkenyl groups having from 2 to 5 carbon atoms, and OH groups, comprising:

- reacting a compound of the formula R<sub>1</sub>-R<sub>2</sub>-Br, wherein R<sub>1</sub> and R<sub>2</sub> have the same meaning as above, with Mg and with a compound of the formula Si-(OR<sub>3</sub>)<sub>4</sub> , 30 wherein R<sub>3</sub> is an alkoxy group having from 1 to 3 carbon atoms, to form a compound of the formula R<sub>1</sub>-R<sub>2</sub>-Si-(OR<sub>3</sub>)<sub>3</sub> , wherein R<sub>1</sub>, R<sub>2</sub> and R<sub>3</sub> have the same meaning as above;
- reacting the thus obtained compound of the formula R<sub>1</sub>-R<sub>2</sub>-Si-(OR<sub>3</sub>)<sub>3</sub> with a halogenating agent capable of replacing, preferably each, R<sub>3</sub> with a halogen

substantially without affecting the rest of the compound of formula R<sub>1</sub>-R<sub>2</sub>-Si-(OR<sub>3</sub>)<sub>3</sub> to produce a compound of the formula R<sub>1</sub>-R<sub>2</sub>-SiX<sub>2</sub>, wherein R<sub>1</sub>, R<sub>2</sub> and X<sub>2</sub> have the same meaning as above, and

- recovering the thus obtained compound.

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58. The of claim 57 for making a chemical compound of the formula R<sub>1</sub>-R<sub>2</sub>-Si-(X<sub>1</sub>)<sub>3</sub>, wherein X<sub>1</sub> is a halogen or alkoxy group, R<sub>2</sub> is an aromatic group having 6 carbon atoms and R<sub>1</sub> is a substituent at position 4 of R<sub>2</sub>, R<sub>1</sub> being selected from an alkyl group having from 1 to 4 carbon atoms, an alkenyl group having from 2 to 5 carbon atoms, or OH, comprising:

- reacting R<sub>1</sub>-R<sub>2</sub>-Br with Mg and Si-(OR<sub>3</sub>)<sub>4</sub> to form R<sub>1</sub>-R<sub>2</sub>-Si-(OR<sub>3</sub>)<sub>3</sub> + BrMgOR, where R<sub>1</sub> is selected from an alkyl group having from 1 to 4 carbon atoms, an alkenyl having from 2 to 5 carbon atoms, R<sub>2</sub> is an aromatic or non-aromatic ring structure having from 5 to 7 carbon atoms, and R<sub>3</sub> is an alkoxy group having from 1 to 3 carbon atoms; and
- reacting R<sub>1</sub>-R<sub>2</sub>-Si-(OR<sub>3</sub>)<sub>3</sub> with 3 SO<sub>2</sub>Cl<sub>2</sub> in the presence of C<sub>5</sub>H<sub>5</sub>N-HCl to yield R<sub>1</sub>-R<sub>2</sub>-SiCl<sub>3</sub> + 3 SO<sub>2</sub> + 3EtCl.

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59. A chemical compound of the formula R<sub>1</sub>-R<sub>2</sub>-Si-(X<sub>1</sub>)<sub>3</sub>, wherein X<sub>1</sub> is a halogen, acyloxy, alkoxy or OH group, R<sub>2</sub> is an organic polycyclic or bridged ring structure with Si bound to carbon position 1, and R<sub>1</sub> is a substituent at position 3 or higher of R<sub>2</sub> selected from an alkyl group having from 1 or more carbons atoms, an alkenyl, an alkynyl, an acrylate, an aryl, an alcohol, OH, H, D, Cl or F.

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60. The compound of claim 59, wherein R<sub>2</sub> is an interlocking ring structure with one of the rings having 6 carbons.

61. The compound of claim 60, wherein R<sub>2</sub> is an interlocking ring structure with one of the rings having 4 carbons.

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62. The compound of claim 61, wherein R<sub>2</sub> is further substituted at positions 3 and 5.

63. The compound of claim 185, wherein R<sub>2</sub> is substituted at positions 3 and 5 with CF<sub>3</sub>.

64. The compound of claim 60, wherein R<sub>2</sub> is an interlocking ring structure with 2 rings, a first ring having at least 4 carbons and a second ring having at least 6 carbons.
65. The compound of any of claims 59 to 64, wherein R<sub>1</sub> has the same meaning as above  
5 in any of claims 30 to 39.
66. The compound of any of claims 59 to 65, wherein X<sub>1</sub> is an alkoxy group, ethoxy group, acyloxy group, an OH group.
- 10 67. The compound of any of claims 59 to 66, wherein R<sub>1</sub> is CH<sub>2</sub>, CH<sub>2</sub>CH<sub>3</sub>, (CH<sub>2</sub>)<sub>2</sub>CH<sub>3</sub>, (CH<sub>2</sub>)CF<sub>3</sub>, CH<sub>2</sub>CH<sub>2</sub>OH or CH<sub>2</sub>CF<sub>2</sub>OH.
- 15 68. A poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain crosslinking groups and -R<sub>1</sub>-R<sub>2</sub> bound to from 5% to 50% of the silicon atoms in the Si-O backbone, wherein R<sub>2</sub> is polycyclic or bridged ring structure and R<sub>1</sub> is a substituent at position 4 of R<sub>2</sub> selected from an alkyl chain having from 1 to 4 carbons, H, D, F or OH.
69. The compound of claim 68, wherein  
X<sub>1</sub> is a halogen, acyloxy, alkoxy or OH group,
- 20 R<sub>2</sub> is an aromatic group having 5 or 6 carbon atoms or a non-aromatic ring structure having from 5 to 7 carbons, and  
R<sub>1</sub> is a substituent at position 4 of R<sub>2</sub> selected from alkyl groups having from 1 to 4 carbon atoms, alkenyl groups having from 2 to 5 carbon atoms, alkynyl groups having from 2 to 5 carbon atoms, and aromatic groups having 5 or 6 carbon atoms, each of said groups being  
25 optionally substituted, and Cl and F.
70. The compound of claim 68 or 69, wherein R<sub>1</sub> is a linear or branched carbon chain having from 1 to 4 carbons, which is optionally fluorinated or perfluorinated.
- 30 71. The compound of any of claims 68 to 70, wherein R<sub>1</sub> is selected from the group consisting of -CF<sub>3</sub>, -CF<sub>2</sub>CF<sub>3</sub>, -CF<sub>2</sub>CF<sub>2</sub>CF<sub>3</sub>, -CF<sub>2</sub>OH, -CF<sub>2</sub>CF<sub>2</sub>OH, -CF<sub>2</sub>(CF<sub>2</sub>)<sub>2</sub>OH, -CF<sub>2</sub>(CF<sub>2</sub>)<sub>2</sub>CF<sub>3</sub>,

$-\text{CF}_2(\text{CF}_2)_3\text{OH}$ , a carbon chain having a carbon-carbon double bond and from 2 to 5 carbons, a vinyl group, an acrylic group, an alkenyl group having from 1 to 4 carbons, and  $-\text{Si}-(\text{X}_2)_3$ , where  $\text{X}_2$  is a halogen.

- 5    72. The compound of any of claims 68 to 71, wherein  $\text{X}_1$  is chlorine or ethoxy,
73. The compound according to any of claims 70 to 72, wherein  $\text{X}_2$  is chlorine.
- 10   74. The compound of any of claims 68 to 73, wherein  $\text{R}_2$  is an aromatic group selected from the group of aromatic groups having 5 or 6 carbon atoms and further being substituted at positions 3 and 5.
- 15   75. The compound of claim 74, wherein  $\text{R}_2$  is substituted at positions 3 and 5 with a group  $-\text{CF}_3$ .
76. The compound of claim 68, wherein  $\text{R}_1$  is  $-\text{CH}_3$ ,  $-\text{CH}_2\text{CH}_3$ ,  $-\text{CH}_2\text{CH}_2\text{CH}_3$ ,  $-(\text{CH}_2)\text{CF}_3$ ,  $-\text{CH}_2\text{CH}_2\text{OH}$  or  $-\text{CH}_2\text{CF}_2\text{OH}$ . wherein  $\text{R}_1$  is a carbon chain of from 1 to 4 carbons.
- 20   77. The compound of claim 68, wherein  $\text{R}_1$  is a carbon chain having a carbon-carbon double bond and from 2 to 5 carbons.
78. The compound of claim 68, wherein  $\text{R}_1$  is a vinyl group.
- 25   79. The compound of claim 68, wherein  $\text{R}_1$  is an acrylic group.
80. The compound of claim 68, wherein  $\text{R}_2$  is a non-aromatic ring structure having from 5 to 7 carbons.
- 30   81. The compound of claim 80, wherein the Si-O backbone further comprises  $\text{R}_3$  groups bound to from 5% to 25% of the silicon atoms in the Si-O backbone, wherein  $\text{R}_3$  is an alkyl chain having from 1 to 4 carbon atoms.

82. The compound of claim 81, wherein R<sub>3</sub> is a non-fluorinated, partially fluorinated or perfluorinated hydrocarbon group, selected from CF<sub>3</sub>, CH<sub>3</sub>, CH<sub>2</sub>CH<sub>3</sub> and CF<sub>2</sub>CF<sub>3</sub>.
83. The compound of claim 81, wherein R<sub>3</sub> is a carbon chain having from 1 to 4 carbon atoms and an -OH group, such as CF<sub>2</sub>OH or CF<sub>2</sub>CF<sub>2</sub>OH.
84. The compound of any of claims 68 to 83, having a dielectric constant of 2.7 or less, preferably 2.5 or less, in particular 2.3 or less.
85. A poly(organo siloxane) compound comprising a repeating Si-O backbone, -R<sub>1</sub>-R<sub>2</sub> bound to from 25% to 50% of the silicon atoms in the Si-O backbone, wherein R<sub>2</sub> is a polycyclic or bridged ring structure and R<sub>1</sub> is a substituent at position 4 of R<sub>2</sub> selected from H, D, F, OH, an alkyl group having from 1 to 4 carbon atoms, and an alkenyl group having from 2 to 5 carbon atoms, and further comprising R<sub>3</sub> bound to from 5% to 50% of the silicon atoms, wherein R<sub>3</sub> is an alkenyl group having from 2 to 5 carbon atoms, acrylic group, aryl group or epoxy group.
86. The compound of claims 85, wherein  
X<sub>1</sub> is a halogen, acyloxy, alkoxy or OH group,  
R<sub>2</sub> is an aromatic group having 5 or 6 carbon atoms or a non-aromatic ring structure having from 5 to 7 carbons, and  
R<sub>1</sub> is a substituent at position 4 of R<sub>2</sub> selected from alkyl groups having from 1 to 4 carbon atoms, alkenyl groups having from 2 to 5 carbon atoms, alkynyl groups having from 2 to 5 carbon atoms, and aromatic groups having 5 or 6 carbon atoms, each of said groups being optionally substituted, and Cl and F.
87. The compound of claims 85 or 86, wherein R<sub>1</sub> is a linear or branched carbon chain having from 1 to 4 carbons, which is optionally fluorinated or perfluorinated.
88. The compound of any of claims 85 to 87, wherein  
R<sub>1</sub> is selected from the group consisting of -CF<sub>3</sub>, -CF<sub>2</sub>CF<sub>3</sub>, -CF<sub>2</sub>CF<sub>2</sub>CF<sub>3</sub>, -CF<sub>2</sub>OH, -CF<sub>2</sub>CF<sub>2</sub>OH, -CF<sub>2</sub>(CF<sub>2</sub>)<sub>2</sub>OH, -CF<sub>2</sub>(CF<sub>2</sub>)<sub>2</sub>CF<sub>3</sub>, -CF<sub>2</sub>(CF<sub>2</sub>)<sub>3</sub>OH, a carbon chain having a carbon-carbon double bond and from 2 to 5 carbons, a vinyl group, an acrylic group, an alkenyl group having from 1 to 4 carbons, and -Si-(X<sub>2</sub>)<sub>3</sub>, where X<sub>2</sub> is a halogen.

89. The compound of any of claims 85 to 88, wherein  $X_1$  is chlorine or ethoxy,
90. The compound according to claims 88 or 89, wherein  $X_2$  is chlorine.
- 5 91. The compound of any of claims 85 to 90, wherein  $R_2$  is an aromatic group selected from the group of aromatic groups having 5 or 6 carbon atoms and further being substituted at positions 3 and 5.
- 10 92. The compound of claim 91, wherein  $R_2$  is substituted at positions 3 and 5 with a group  $-CF_3$ .
93. The compound of claim 85, wherein  $R_1$  is  $-CH_3$ ,  $-CH_2CH_3$ ,  $-CH_2CH_2CH_3$ ,  $-(CH_2)CF_3$ ,  $-CH_2CH_2OH$  or  $-CH_2CF_2OH$ .
- 15 94. The compound of claim 85, wherein  $R_1$  is  $CH_2$ ,  $CH_2CH_3$ ,  $(CH_2)_2CH_3$ ,  $(CH_2)CF_3$ ,  $CH_2CH_2OH$  or  $CH_2CF_2OH$ .
95. The compound of claim 85, wherein  $R_3$  is an epoxy group, such as glycidoxypropyl, 20 or an acrylic group, such as a methacrylic group, an alkenyl group having from 2 to 5 carbon atoms, such as vinyl, or phenyl .
96. The compound of any of claims 85 to 95, further comprising  $R_4$  groups bound to from 25 5 to 50% of the silicon atoms of the Si-O backbone, wherein  $R_4$  is an alkyl group having from 1 to 4 carbon atoms.
97. The compound of claim 96, wherein  $R_4$  is  $CH_3$ ,  $CH_2CH_3$ ,  $(CH_2)_2CH_3$ ,  $CF_3$ ,  $CF_2CF_3$ ,  $(CF_2)_2CF_3$ .
- 30 98. The compound of any of claims 85 to 97, having a dielectric constant of 2.7 or less, preferably 2.5 or less, in particular 2.3 or less.
99. An integrated circuit having a layer with areas of an electrically conductive first material and an electrically insulating second material, wherein the second material is a

poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain crosslinking groups and -R1-R2 bound to from 5% to 50% of the silicon atoms in the Si-O backbone, wherein R2 is a polycyclic or bridged ring structure and R1 is a substituent at position 4 of R2 selected from H, D, F, OH, an alkyl group having from 1 to 4 carbon atoms, and an alkenyl group having from 2 to 5 carbon atoms.

100. The compound of claim 99, wherein R1 is a carbon chain of from 1 to 4 carbons, which is optionally fluorinated or perfluorinated.

10 101. The compound of claim 99 or 100, wherein R1 is a branched carbon chain.

102. The compound of claim 99, wherein R1 is CF<sub>3</sub>, CF<sub>2</sub>CF<sub>3</sub>, CF<sub>2</sub>CF<sub>2</sub>CF<sub>3</sub>, CF<sub>2</sub>OH, CF<sub>2</sub>CF<sub>2</sub>OH or (CF<sub>2</sub>)<sub>3</sub>OH, (CF<sub>2</sub>)<sub>3</sub>CF<sub>3</sub>, (CF<sub>2</sub>)<sub>4</sub>OH.

15 103. A computer comprising an integrated circuit having a layer with areas of an electrically conductive first material and an electrically insulating second material, wherein the second material is a poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain crosslinking groups and -R1-R2 bound to from 5% to 50% of the silicon atoms in the Si-O backbone, wherein R2 is a polycyclic or bridged ring structure and R1 is a substituent at position 4 of R2.

20 104. A method for making an integrated circuit, comprising providing alternating areas of electrically insulating and electrically conducting materials within a layer on a semiconductor substrate, wherein the electrically insulating material comprises a poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain crosslinking groups and -R1-R2 bound to from 5% to 50% of the silicon atoms in the Si-O backbone, wherein R2 is a polycyclic or bridged ring structure and R1 is a substituent at position 4 of R2 selected from an alkyl chain having from 1 to 4 carbons, H, D, F or OH.

30 105. The method of claim 104, wherein the electrically insulating material is deposited, baked and patterned, with the electrically conductive material being deposited in removed areas of the patterned dielectric.

106. The method of claim 106, wherein the electrically conductive material comprises copper.

107. The method of claim 318, which is a dual damascene process.

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108. A chemical compound of the formula R1-R2-Si-(X1)3, wherein X1 is a halogen, acyloxy, alkoxy or OH group, R2 is an aromatic group having 8 carbon atoms and R1 is a substituent at position 5 of R2 selected from an alkyl group having from 1 to 4 carbon atoms, an alkenyl group having from 2 to 5 carbon atoms, an alkynyl group having from 2 to 5 carbon atoms, Cl or F.

10

109. The compound of claim 108, wherein R1, R2 and X1 have the same meaning as above in any of claims 11 to 22.

15

110. The compound of claim 108 or 109, wherein R2 is further substituted at positions 4 and 6.

111. The compound of claim 110, wherein R2 is substituted at positions 4 and 6 with CF<sub>3</sub>.

20

112. The compound of any of claims 108 to 111, wherein R2 is a non-aromatic ring structure having from 5 to 7 carbons.

25

113. A poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain crosslinking groups and -R1-R2 bound to from 5% to 50% of the silicon atoms in the Si-O backbone, wherein R2 is an aromatic group having 8 carbon atoms and R1 is a substituent at position 5 of R2.

114. The compound of claim 113, wherein R1, R2 and X1 have the same meaning as above in any of claims 11 to 22.

30

115. The compound of claim 113, wherein R2 is further substituted at positions 4 and 6.

116. The compound of claim 115, wherein R2 is substituted at positions 4 and 6 with CF<sub>3</sub>.

117. The compound of any of claims 113 to 116, wherein R2 is a non-aromatic ring structure having from 5 to 7 carbons.

118. The compound of any of claims 113 to 116, wherein the Si-O backbone further 5 comprises R3 groups bound to from 5% to 25% of the silicon atoms in the Si-O backbone, wherein R3 is an alkyl chain having from 1 to 4 carbon atoms, an alkenyl chain or aryl group.

119. The compound of claim 118, wherein R3 is a non-fluorinated, partially fluorinated or 10 perfluorinated hydrocarbon group, selected from CF<sub>3</sub>, CH<sub>3</sub>, CH<sub>2</sub>CH<sub>3</sub> and CF<sub>2</sub>CF<sub>3</sub>.

120. The compound of claim 119, wherein R3 is a carbon chain having from 1 to 4 carbon atoms and an -OH group, such as CF<sub>2</sub>OH or CF<sub>2</sub>CF<sub>2</sub>OH.

15 121. The compound of any of claims 113 to 120, having a dielectric constant of 2.7 or less, preferably 2.5 or less, in particular 2.3 or less.

122. A poly(organo siloxane) compound comprising a repeating Si-O backbone, -R<sub>1</sub>-R<sub>2</sub> bound to from 25% to 50% of the silicon atoms in the Si-O backbone, wherein R<sub>2</sub> is an 20 aromatic group having 8 carbon atoms and R<sub>1</sub> is a substituent at position 5 of R<sub>2</sub> (again this could be drawn out for clarity), and R<sub>3</sub> bound to from 5% to 50% of the silicon atoms, wherein R<sub>3</sub> is an alkenyl group having from 2 to 5 carbon atoms, acrylic group or epoxy group.

25 123. The compound of claim 122, wherein the substituents R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, X<sub>1</sub> and X<sub>2</sub> have the same meaning as above in any of claims 30 to 39.

124. The compound of claim 122 or 123, further comprising R<sub>4</sub> groups bound to from 5 to 30 50% of the silicon atoms of the Si-O backbone, wherein R<sub>4</sub> is an alkyl group having from 1 to 4 carbon atoms.

125. The compound of claim 124, wherein R<sub>4</sub> is CH<sub>3</sub>, CH<sub>2</sub>CH<sub>3</sub>, (CH<sub>2</sub>)<sub>2</sub>CH<sub>3</sub>, CF<sub>3</sub>, CF<sub>2</sub>CF<sub>3</sub>, (CF<sub>2</sub>)<sub>2</sub>CF<sub>3</sub>.

126. The compound of any of claims 122 to 125, having a dielectric constant of 2.7 or less, preferably 2.5 or less, in particular 2.3 or less.

127. An integrated circuit having a layer with areas of an electrically conductive first material and an electrically insulating second material, wherein the second material is a poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain crosslinking groups and -R1-R2 bound to from 5% to 50% of the silicon atoms in the Si-O backbone, wherein R2 is an aromatic group having 8 carbon atoms and R1 is a substituent at position 5 of R2.

10

128. The circuit of claim 447, wherein R1, R2 and X2 have the same meaning as in any of claims 30 to 39.

129. A computer comprising an integrated circuit having a layer with areas of an electrically conductive first material and an electrically insulating second material, wherein the second material is a poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain crosslinking groups and -R1-R2 bound to from 5% to 50% of the silicon atoms in the Si-O backbone, wherein R2 is an aromatic group having 8 carbon atoms and R1 is a substituent at position 5 of R2.

15

130. A method for making an integrated circuit, comprising providing alternating areas of electrically insulating and electrically conducting materials within a layer on a semiconductor substrate, wherein the electrically insulating material comprises a poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain crosslinking groups and -R1-R2 bound to from 5% to 50% of the silicon atoms in the Si-O backbone, wherein R2 is an aromatic group having 8 carbon atoms and R1 is a substituent at position 5 of R2 selected from an alkyl chain having from 1 to 4 carbons, an alkenyl group having from 2 to 6 carbons or OH.

20

131. The method of claim 130, wherein the electrically insulating material is deposited, baked and patterned, with the electrically conductive material being deposited in removed areas of the patterned dielectric.

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132. The method of claim 131, wherein the electrically conductive material comprises copper.

133. The method of claim 132, which is a dual damascene process.

5

134. A chemical compound of the formula R1-R2-Si-(X1)3, wherein X1 is a halogen, acyloxy, alkoxy or OH group, R2 is an aromatic group having 10 carbon atoms and R1 is a substituent at position 6 of R2 selected from an alkyl group having from 1 to 4 carbon atoms, an alkenyl group having from 2 to 5 carbon atoms, an alkynyl group having from 2 to 5 carbon atoms, Cl or F.

135. The compound of claim 134, wherein R1, R2, X1 and X2 have the same meaning as in any of claims 30 to 39.

15 136. The compound of claim 134 or 135, wherein R2 is a phenyl group, optionally substituted at positions 5 and 7.

137. The compound of claim 136, wherein R2 is substituted at positions 5 and 7 with CF3.

20 138. The compound of claim 134 or 135, wherein R2 is a non-aromatic ring structure having from 5 to 7 carbons.

139. A poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain crosslinking groups and -R1-R2 bound to from 5% to 50% of the silicon atoms in the 25 Si-O backbone, wherein R2 is an aromatic group having 10 carbon atoms and R1 is a substituent at position 6 of R2.

140. The compound of claim 139, wherein R1, R2 and X2 have the same meaning as in any of claims 30 to 39 above.

30

141. The compound of claim 140, wherein R2 is a phenyl group, optionally substituted at positions 5 and 7.

142. The compound of claim 141, wherein R2 is substituted at positions 5 and 7 with CF3.

143. The compound of claim 139, wherein R2 is a non-aromatic ring structure having from 5 to 7 carbons.

5 144. The compound of claim 139, wherein the Si-O backbone further comprises R3 groups bound to from 5% to 25% of the silicon atoms in the Si-O backbone, wherein R3 is an alkyl chain having from 1 to 4 carbon atoms, an alkenyl chain or aryl group

10 145. The compound of claim 144, wherein R3 is a non-fluorinated, partially fluorinated or perfluorinated hydrocarbon group, having a carbon chain of 1 to 4 carbon atoms and optionally containing an -OH group.

146. The compound of claim 146, wherein R3 is CF<sub>3</sub>, CH<sub>3</sub>, CH<sub>2</sub>CH<sub>3</sub>, CF<sub>2</sub>CF<sub>3</sub>, CF<sub>2</sub>OH or CF<sub>2</sub>CF<sub>2</sub>OH.

15

147. The compound of any of claims 139 to 146, having a dielectric constant of 2.7 or less, preferably 2.5 or less, in particular 2.3 or less.

20 148. A poly(organo siloxane) compound comprising a repeating Si-O backbone, -R<sub>1</sub>-R<sub>2</sub> bound to from 25% to 50% of the silicon atoms in the Si-O backbone, wherein R<sub>2</sub> is an aromatic group having 10 carbon atoms and R<sub>1</sub> is a substituent at position 6 of R<sub>2</sub>, and R<sub>3</sub> bound to from 5% to 50% of the silicon atoms, wherein R<sub>3</sub> is an alkenyl group having from 2 to 5 carbon atoms, acrylic group or epoxy group.

25 149. The compound of claims 148, wherein R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, X<sub>2</sub> have the same meaning as above in any of claims 30 to 39.

30 150. The compound of claim 149, further comprising R<sub>4</sub> groups bound to from 5 to 50% of the silicon atoms of the Si-O backbone, wherein R<sub>4</sub> is an alkyl group having from 1 to 4 carbon atoms.

151. The compound of claim 150, wherein R<sub>4</sub> is CH<sub>3</sub>, CH<sub>2</sub>CH<sub>3</sub>, (CH<sub>2</sub>)<sub>2</sub>CH<sub>3</sub>, CF<sub>3</sub>, CF<sub>2</sub>CF<sub>3</sub>, (CF<sub>2</sub>)<sub>2</sub>CF<sub>3</sub>.

152. The compound of any of claims 148 to 151, having a dielectric constant of 2.7 or less, preferably 2.5 or less, in particular 2.3 or less.

153. An integrated circuit having a layer with areas of an electrically conductive first material and an electrically insulating second material, wherein the second material is a poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain crosslinking groups and -R1-R2 bound to from 5% to 50% of the silicon atoms in the Si-O backbone, wherein R2 is an aromatic group having 10 carbon atoms and R1 is a substituent at position 6 of R2.

10

154. The compound of claim 153, wherein R1, R2 and X2 have the same meaning as above in any of claims 30 to 39.

155. A computer comprising an integrated circuit having a layer with areas of an electrically conductive first material and an electrically insulating second material, wherein the second material is a poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain crosslinking groups and -R1-R2 bound to from 5% to 50% of the silicon atoms in the Si-O backbone, wherein R2 is an aromatic group having 10 carbon atoms and R1 is a substituent at position 6 of R2.

20

156. A method for making an integrated circuit, comprising providing alternating areas of electrically insulating and electrically conducting materials within a layer on a semiconductor substrate, wherein the electrically insulating material comprises a poly(organo siloxane) compound comprising a repeating Si-O backbone, carbon chain crosslinking groups and -R1-R2 bound to from 5% to 50% of the silicon atoms in the Si-O backbone, wherein R2 is an aromatic group having 10 carbon atoms and R1 is a substituent at position 6 of R2 selected from an alkyl chain having from 1 to 4 carbons, an alkenyl group having from 2 to 6 carbons or OH.

30 157. The method of claim 156, wherein the electrically insulating material is deposited, baked and patterned, with the electrically conductive material being deposited in removed areas of the patterned dielectric.

158. The method of claim 157, wherein the electrically conductive material comprises copper.

159. The method of claim 158, which is a dual damascene process.

5

160. A method for making a chemical compound of the formula R1-R2-Si-(X1)3, wherein X1 is a halogen or alkoxy group, R2 is an aromatic group having 10 carbon atoms and R1 is a substituent at position 6 of R2, R1 being selected from an alkyl group having from 1 to 4 carbon atoms, an alkenyl group having from 2 to 5 carbon atoms, or OH, comprising:

10 reacting R1-R2-Br with Mg and Si-(OR<sub>3</sub>)<sub>4</sub> to form R1-R2-Si-(OR<sub>3</sub>)<sub>3</sub> + BrMgOR, where R1 is selected from an alkyl group having from 1 to 4 carbon atoms, an alkenyl having from 2 to 5 carbon atoms, R2 is an aromatic or non-aromatic ring structure having from 5 to 7 carbon atoms, and R3 is an alkoxy group having from 1 to 3 carbon atoms;

15 reacting R1-R2-Si-(OR<sub>3</sub>)<sub>3</sub> with 3 SO<sub>2</sub>Cl<sub>2</sub> in the presence of C<sub>5</sub>H<sub>5</sub>N-HCl to yield R1-R2-SiCl<sub>3</sub> + 3 SO<sub>2</sub> + 3EtCl.

161. The compound of claim 1, wherein R2 is further substituted at positions 3 and 4.

20 162. The compound of claim 161, wherein R2 is substituted at positions 3 and 4 with CF<sub>3</sub>.

163. The compound of claim 161 or 162, wherein R2 is substituted at position 3 with CF<sub>3</sub> and at position 4 with CH<sub>3</sub>.

25 164. A thin film comprising a composition obtained by hydrolyzing

- a monomeric silicon compound having at least one hydrocarbyl radical, containing an unsaturated carbon-to-carbon bond, and at least one hydrolyzable group attached to the silicon atom of the compound with
- another monomeric silicon compound having at least one aryl group and at least one hydrolyzable group attached to the silicon atom of the compound to form a siloxane material.

30

165. The thin film according to claim 164, wherein the composition comprises a cross-linked poly(organosiloxane).

166. The thin film according to claim 164, wherein the composition comprises a poly(organosiloxane) obtained by

5 hydrolyzing a first silicon compound having the general formula I



I

10 wherein  $Y_1$  represents a hydrolyzable group;  
R1 is an aromatic group having 6 carbon atoms and R1 is a substituent at position 4 of R1 selected from an alkyl group having from 1 to 4 carbon atoms, an alkenyl group having from 2 to 5 carbon atoms, an alkynyl group having from 2 to 5 carbon atoms, Cl or F;

15 R2 and R3 are independently selected from hydrogen, substituted or non-substituted alkyl groups, substituted or non-substituted alkenyl and alkynyl groups, and substituted or non-substituted aryl groups; a is an integer 0, 1 or 2;

20 b is an integer  $a+1$ ;

c is an integer 0, 1 or 2;

d is an integer 0 or 1; and

$$b + c + d = 3$$

25 with a second silicon compound having the general formula II



II

30 wherein  $Y_2$  represents a hydrolyzable group;  
R4 is an aromatic group having 6 carbon atoms and R4 is a substituent at position 4 of R4 selected from an alkyl group having from 1 to 4 carbon atoms, an alkenyl group having from 2 to 5

carbon atoms, an alkynyl group having from 2 to 5 carbon atoms, Cl or F;

R5 and R6 are independently selected from hydrogen, substituted or non-substituted alkyl groups, substituted or non-substituted alkenyl and alkynyl groups, and substituted or non-substituted aryl groups;  
5 e is an integer 0, 1 or 2;

f is an integer e+1;

g is an integer 0, 1 or 2;

h is an integer 0 or 1; and

10 f + g + h = 3.